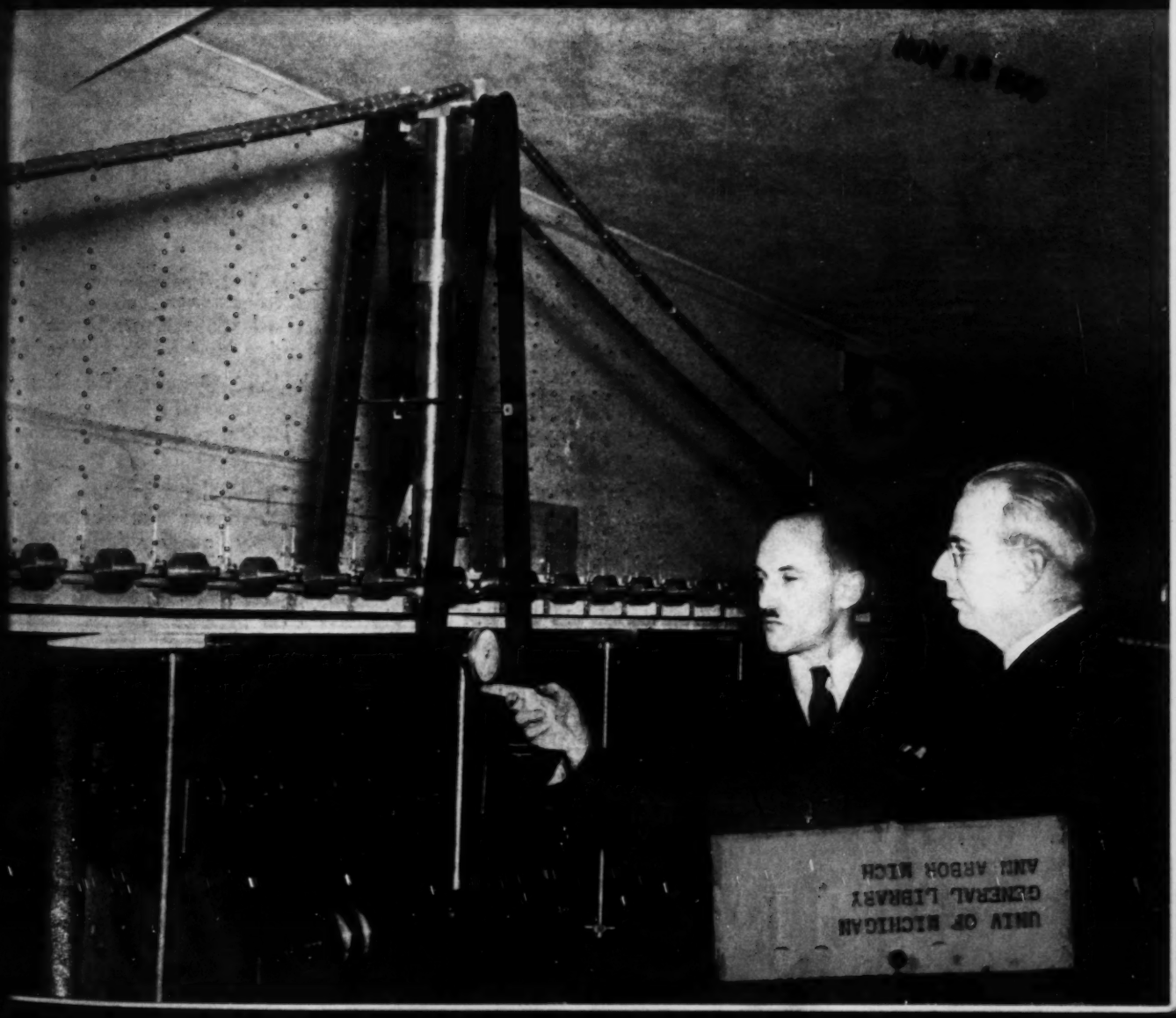
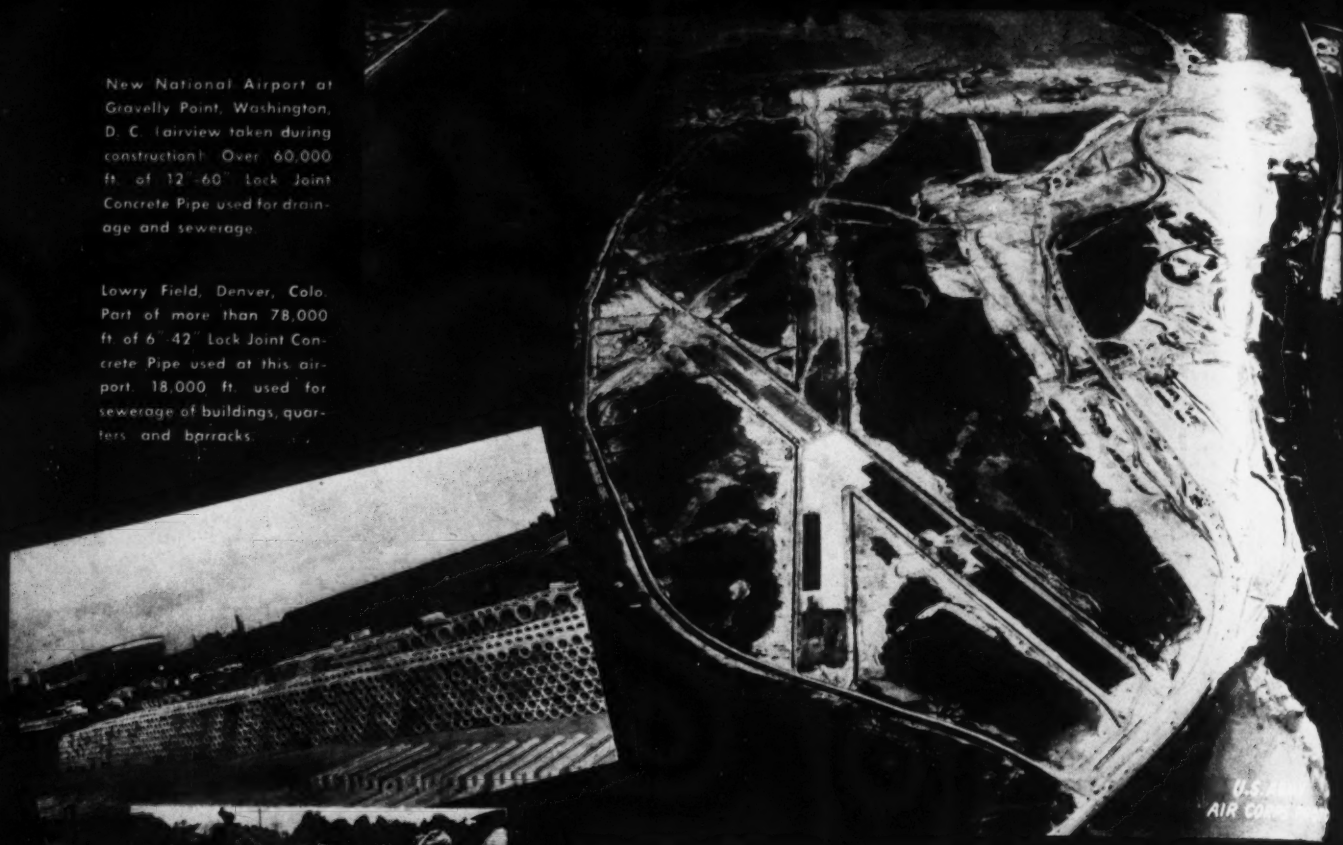
ENGINEERING NEWS-RECORD

Model studies of wave motion of Tacoma Bridge in progress as span fails—*See p. 1*



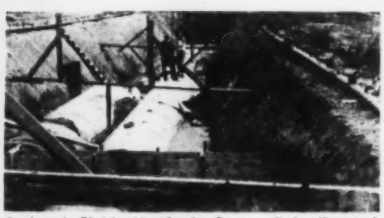
New National Airport at Gravelly Point, Washington, D. C. Fairview taken during construction. Over 60,000 ft. of 12"-60" Lock Joint Concrete Pipe used for drainage and sewerage.

Lowry Field, Denver, Colo. Part of more than 78,000 ft. of 6"-42" Lock Joint Concrete Pipe used at this airport. 18,000 ft. used for sewerage of buildings, quarters and barracks.

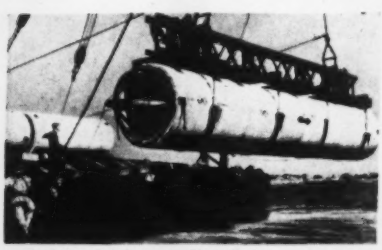


LOCK JOINT PIPE

Water Supply is a vital part of National Defense. Lock Joint Reinforced Concrete Pressure Pipe is the ideal material for water transmission because of its maximum hydraulic usefulness. View shows part of 52,000 ft. of 30"-36" pipe being laid at Norfolk, Va.



Brainard Field, Hartford, Conn. Twin lines of 66" Lock Joint Concrete Pipe under Clark Dike. Flood control for the protection of airports and industrial centers is essential to National Defense.



Lock Joint Subaqueous Pipe finds many uses on projects located near large bodies of water—intakes for fresh or salt water supplies for processing or cooling; outfalls for the disposal of wastes. View shows 72" outfall at Coney Island Sewage Treatment Works.

FOR DEFENSE CONSTRUCTION

In Defense Construction speed in essential—but quality must not be sacrificed.

Ten permanent plants, strategically located throughout the country, carry large stocks of Lock Joint sewer, culvert and drain pipe available for immediate use. On large projects the pipe can be manufactured right at the site, using local labor and materials.

The recognized quality of Lock Joint Concrete Pipe is maintained through careful control of every process in its production, by men especially skilled in the fabrication of plain and reinforced concrete pipe.

The views on this page show several of the many uses for Lock Joint Concrete Pipe in National Defense work. These include sewers, culverts, drains and water supply lines for Airports, Army and Navy Bases, Municipalities, Power Projects, Factories, Railroads and Highways. Lock Joint Concrete Pipe can be supplied in sizes from 6" to 150" in diameter—and for pressures from zero to 600 feet of head.

You'll find a representative at any one of our permanent plants prepared to help you in every way.

PLANTS ARE LOCATED IN THE FOLLOWING CITIES:

DENVER, COLO.
GREAT BEND, KAN.
KANSAS CITY, MO.
VALLEY PARK, MO.
ROCK ISLAND, ILL.
CHICAGO, ILL.
CLEVELAND, OHIO
KENILWORTH, N. J.
WHITE PLAINS, N. Y.
HARTFORD, CONN.

LOCK JOINT *Plain and Reinforced* CONCRETE PIPE

LOCK JOINT PIPE CO. Established 1905 AMPERE, N. J.

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • NOVEMBER 14, 1940

Tacoma Narrows Bridge wrecked by wind

Roadway and stiffening girders of 2,800-ft. central span wrenched off and torn to pieces after 42-mi. wind set up violent waving and twisting. Towers bent backward 12 ft. under pull of surviving side spans and plates buckled. Wavelike oscillation of deck gave trouble ever since construction, but was not thought dangerous

N. A. Bowers
Pacific Coast Editor, Engineering News-Record

Wind wrecked the 2,800-ft. main span of the Tacoma Narrows suspension bridge shortly before noon Thursday, Nov. 7. Almost the entire suspended structure between the towers was ripped away and fell into the waters below, but the 1,100-ft. side spans remained intact. Cables and towers survived and held up the weight of the side spans, though the latter sagged about 30 ft. as the towers, which are fixed at the base by steel anchors deeply embedded in the concrete piers, were bent back sharply by the unbalanced pull of the side-span cables.

Fortunately there was no loss of life, as only a few persons were on the bridge. Traffic had been limited or shut off some time before because of the excessive and dangerous motion of the bridge. Among those on the span at the time was Prof. F. B. Farquharson, of the University of Washington (Seattle), who had been conducting extended experiments on a model of the bridge with a view to controlling its oscillation. At the time of the collapse he was on the main span taking motion pictures of the abnormal waving and twisting.

Wind conditions not abnormal

A wind reported as 42 mph was blowing on the morning of the accident. Higher winds had been experienced previously without damage, but this wind caused a vertical wave motion that developed a lag or phase difference between opposite sides of the bridge, giving the deck a cumulative rocking or side-to-side rolling motion.

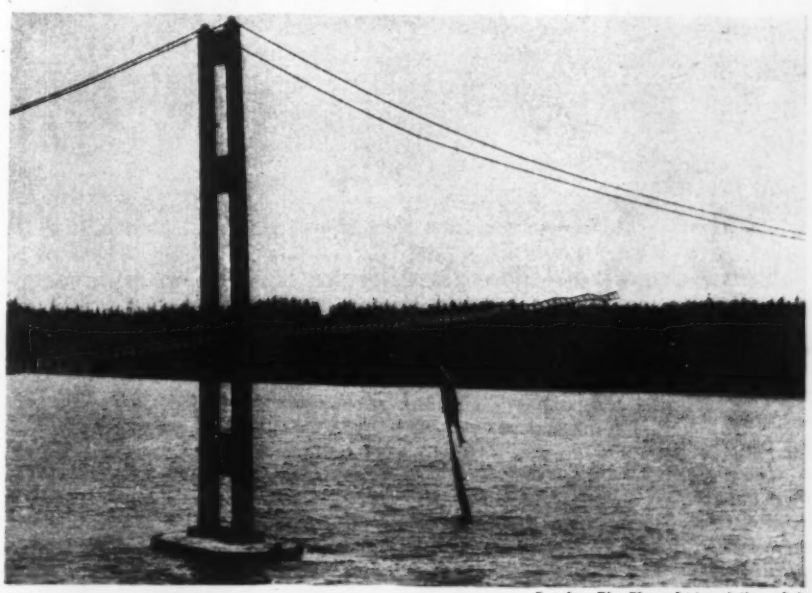
Failure appeared to begin at midspan with buckling of the stiffening girders, although lateral bracing may have gone first. Suspenders snapped and their ends jerked high in the air above the main cables, while sections of the floor system several hundred feet in length fell out successively, breaking up the roadway toward the towers until only stubs remained.

Efforts to check wave motion

Tie-down cables that had been put in the side spans to damp out vertical wave motion previously observed on the bridge are credited with having prevented the violent waves in the main span from being transmitted to the side spans and perhaps doing greater damage to the towers. However, with the load removed from the main spans by the fall of the floor, the side spans sagged 30 ft. making the check reins inoperative and permitting a movement which buckled the stiffening girders and deformed the steel in the floor system.

Under the unbalanced loading the towers were bent back 12 ft. shoreward (about twice the designed maximum) until unloading of the side spans began, when the tower deflection gradually decreased. Outward evidences of tower damage are buckled plates and angles, especially near the piers where plate thicknesses are ½ to ¾ in. An inspector reports that the cables show no evi-

(Continued on p. 10)



Douglas Fir Plywood Association photo

Falling center span of the Tacoma Narrows Bridge

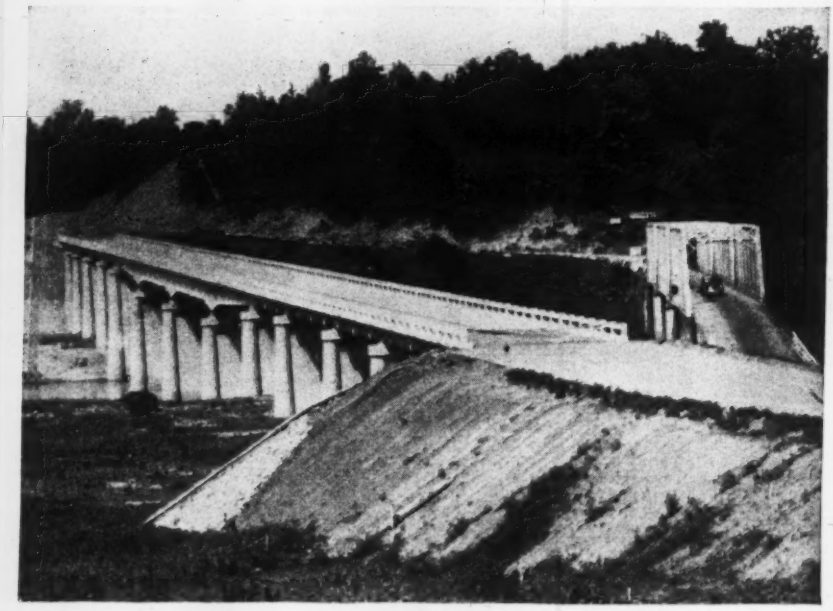
Swinging and twisting in a high wind on Nov. 7 the 2,800-ft. central span of the recently completed Tacoma Narrows Bridge was destroyed, its roadway ripped off and torn apart, leaving the 425-ft. towers bent back under the pull of the surviving side spans.

Defense housing approved for 63 areas

President Roosevelt, acting on the recommendations received from Charles F. Palmer, defense housing coordinator, last month approved immediate construction of housing projects at the 63 sites listed below. The President, in a letter authorizing Federal Works Administrator John M. Carmody to start construction, stated that federal funds are being used for the projects only because private capital cannot be expected to meet temporary needs. This work is in addition to the allocation of $44,240,000 by the President directly to the Navy, Sept. 26, for housing.

Largest of the 63 projects is San Diego, Cal., center of intense West Coast defense activities. At that point the Navy is already constructing 1,200 family dwelling units, and the new proposal calls for construction of 2,000 additional dwelling units and 750 dormitory rooms for single men, these latter dormitories to be constructed immediately.

San Diego, Cal.
Tucson, Ariz.
Benicia, Cal.
Fresno, Cal.
San Rafael, Cal.
Stockton, Cal.
Sunnyvale, Cal.
Delaware City, Del.
Orlando, Fla.
Tallahassee, Fla.
West Palm Beach, Fla.
Augusta, Ga.
Belleville, Ill.
Boise, Idaho
Savanna, Ill.
Bangor, Me.
Aberdeen, Md.
Edgewood, Md.
Jackson, Miss.
Long Branch, N. J.
Albuquerque, N. M.
Houston, Tex.
San Angelo, Tex.
Lee Hall, Va.
Fort Huachuca, Ariz.
Riverside, Cal.
Denver, Colo.
Lowry Field, Colo.
Tampa, Fla.
Columbus, Ga.
Rossville, Ga.
Savannah, Ga.
Rantoul, Ill.
Corydon, Iowa
Rolla, Mo.
Fort Riley, Kans.
Baltimore, Md.
Fort Devens, Mass.
Chicopee, Mass.
Battle Creek, Mich.
Mt. Clemens, Mich.
Fort Dix, N. J.
Fishers Is. Village, N. Y.
Hempstead, L. I., N. Y.
Fayetteville, N. C.
Fort Sill, Okla.
Columbia, S. C.
Fort Meade, S. D.
El Paso, Tex.
Fort Clark, Tex.
San Antonio, Tex.
Arlington, Va.
Virginia Beach, Va.
Langley Field, Va.
Phoebus, Va.
South Tacoma, Wash.
Spokane, Wash.
Island Oahu, T. H.
Puerto Rico
Fort Ord, Cal.
Fort Knox, Ky.
Fort Lewis, Wash.
Odenton, Md.



South Carolina—Georgia highway bridge completed

Known as the Louie Morris Bridge, a new highway span across the Savannah River on Route 29 between Hartwell, Ga. and Anderson, S. C., was dedicated Oct. 11 and opened to traffic. Built by the South Carolina State Highway Department, the work was carried out as a federal-aid project with the PWA supplying about half the total cost of $250,000 and the states of South Carolina and Georgia sharing the remainder. The project, begun March 1939, replaces the outdated steel-truss crossing shown at the right.

The bridge is about 1,056 ft. long with a 24-ft. roadway provided. It consists of steel girders supported on concrete piers founded on rock with concrete deck slab and rail. The span arrangement over the channel proper is a four-span continuous unit with the end spans being 97.5 ft. and the two interior spans about 120 ft. Each of the identical approaches consists of two 50-ft. simple I-beam spans and a three-span continuous unit with two 65-ft. spans and one 80-ft. span. The bridge is designed for a standard H-15 loading.

C. Y. Thomason, Greenwood, S. C., held the contract for the substructure work; the Vincennes Steel Corp., Vincennes, Ind. did the superstructure work. James Gooding, bridge engineer, represented the South Carolina State Highway Department on the project.

General Hartman reviews Army construction

In an address before the Washington Building Congress on November 5, Brig. Gen. C. D. Hartman, chief, Construction Division, Office of the Quartermaster General, outlined the status of the War Department's construction program. "At this moment," said General Hartman, "the construction division of the Quartermaster Corps is charged with the expenditure of $1,147,000,000 covering 265 separate and distinct projects pretty well distributed over the country."

General Hartman stated that 20 of the projects are manufacturing plants, 14 are storage warehouse projects, while 231 are for troop housing. Of the troop projects, 71 are air corps training establishments, 106 are enlargements to existing Army posts, 54 consist of entirely new camps, and 31 of the projects are large cantonments, each capable of housing one or more divisions of 20,000 men. Total funds available for temporary Army housing are $540,000,000. All troop housing will be complete by June 1, 1941 said General Hartman and, of this, 90 per cent will have been completed by January 1, 1940.

General Hartman revealed that 13 more ordnance production plants will be added to the 20 under contract between now and December 15. Six of these will exceed $10,000,000 each while the other 7 will range in cost from $3,000,000 to $7,000,000 each. In addition to these projects there are 10 chemical warfare service plants which will cost from $130,000 to $2,000,000 each.

. . .

Reservoir capacity threatened by erosion

About one-fifth of the nation's water supply reservoirs will be useless in fifty years if eroded soil continues flowing into them at present rates, Carl B. Brown of the U. S. Soil Conservation Service told the Four States Section of the American Water Works Association, which met in Wilmington, Del., Nov. 7-8. In reporting on extensive studies of reservoir silting, Brown stated that another 25 per cent of the country's storage basins might be filled to the point of uselessness in 50 to 100 years and only 54 per cent will last for more than a century. In making these estimates it was assumed that decrease of capacity to 20 per cent of that originally provided will, on an average, terminate the useful life of a reservoir.

Pointing out that the cost of cleaning out a reservoir is nearly always prohibitive, the soil conservation sedimentation specialist outlined three practical methods for silt control: (1) adequate con-

Engineering News-Record is published every Thursday by McGraw-Hill Publishing Company, Inc., at 99-129 North Broadway, Albany, N. Y. Editorial and business offices 330 West 42nd St., New York, N. Y. Subscription, domestic, Canada, Mexico, Central and South American countries $5 for one year, $8 for two years, $10 for three years. Great Britain and British Possessions 54 shillings for one year, 108 shillings for three years. All other countries $9 for one year, $18 for three years. Entered as second class matter October 29, 1936, at the Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C. Copyright 1940 by McGraw-Hill Publishing Co., Inc. James H. McGraw, Founder and Honorary Chairman; James H. McGraw, Jr., President; Howard Ehrlich, Executive Vice-President; Mason Britton, Vice-Chairman; B. R. Putnam, Treasurer; D. C. McGraw, Secretary; J. E. Blackburn, Jr., Circulation Manager.

sideration of the silting factors in the original location and design of the dam; (2) a plan of water release designed to vent the largest possible amount of sediment before it has a chance to deposit and compact; and (3) watershed protection through land purchase or cooperation with land owners to control soil erosion.

Other papers at the meeting, which was attended by 160 waterworks men from Pennsylvania, Delaware, Maryland and the District of Columbia, dealt with flood forecasting, filter washing, insurance requirements for waterworks properties and distribution system maintenance practice.

Edward Hopkins, filtration engineer, Baltimore, was elected chairman of the Four States Section, to succeed I. M. Glace, consulting engineer, Harrisburg, Pa. C. A. Hechmer, department engineer, Washington Suburban Sanitary District, was made vice chairman, and Lloyd Nelson, eastern manager, U. S. Pipe & Foundry Co., Philadelphia, was elected secretary-treasurer.

• • •

Engineering examiners act on fee diversions

Diversion of registration fees paid by engineers for other than professional purposes was opposed in a resolution adopted by the National Council of State Boards of Engineering Examiners at its 21st annual meeting held in Charleston, S. C., Oct. 28-31. The council urged state professional societies and the local sections of the national engineering societies to promote legislation designed to place control of these funds in the hands of state departments charged with the administration of license and registration laws.

The council also went on record as opposing a model license law approved by the board of directors of the American Institute of Electrical Engineers in June, 1939. A resolution was adopted opposing inclusion of the principal features of this proposed law in state license laws. That law would limit licensing to "professional services for hire to the public or in public employment".

The council's distinguished service certificate was awarded to T. Keith Legaré at the annual dinner. Legaré has served the council as executive secretary for 17 years and was reelected to that office this year. Other officers elected were: president, Virgil M. Palmer, Rochester, N. Y.; vice president, C. C. Knipmeyer, Terre Haute, Ind.; directors, H. T. Person, Laramie, Wyo., Roy M. Green, Lincoln, Neb., R. S. King, Atlanta, Ga., and W. W. Hodge, Morgantown, W. Va.

Fairchild Aerial Surveys photo

New highway links proposed in New York

Construction of four major links in the arterial highway systems serving New York City is proposed in a report submitted to Mayor La Guardia on Nov. 11 by Robert Moses, chairman of the Triborough Bridge Authority. The mayor had asked Commissioner Moses for a report on highways needed in the metropolitan district as a defense measure.

Three of the projects are within the city limits and the fourth, Pelham-Portchester Express Highway, is partly in the city but largely in Westchester County. Construction would cost $41,500,000 and land acquisition, $23,500,000, a total of $65,000,000. Land owned by the city and county valued at $11,000,000 also would be used for the projects. Moses states that the needed funds should be obtained from federal appropriations for national defense.

The Pelham-Portchester Highway is designed to relieve congestion on the Boston Post Road. It would be a 6-lane road 15 miles long and parallels the New Haven R. R. tracks for most of its length from Pelham Bay Park to the Connecticut line. Construction would cost $14,000,000, exclusive of land. Part of this highway is shown at the top of the accompanying airview.

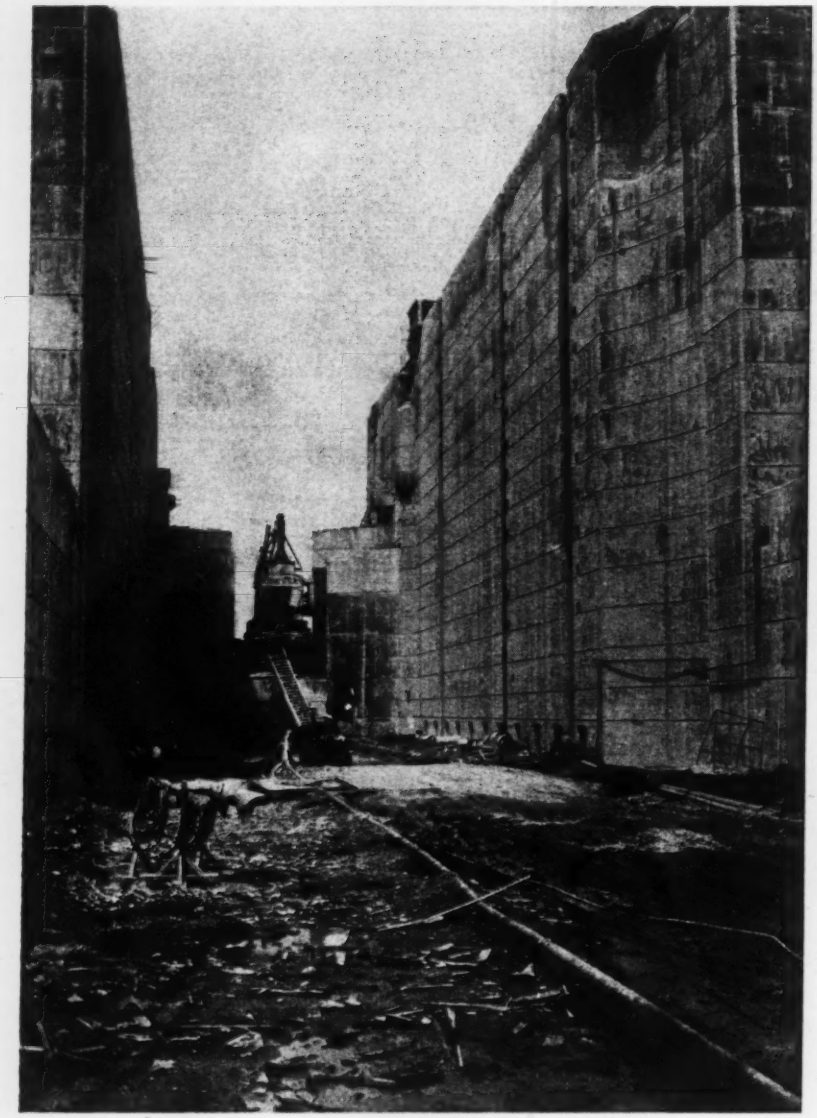
Harlem River Drive, also a six-lane road, is shown in the upper left of the air view. It would provide better connections between George Washington Bridge on the west with the Triborough Bridge to Long Island and the East River Drive. Construction costs would total $11,700,000.

In the lower left corner is the proposed elevated highway parallel to Canal St. to provide connections between Holland Tunnel and the Manhattan and Williamsburg bridges. Its construction cost is estimated at $10,300,000, and $8,800,000 of land would be required as it would be largely on private right-of-way.

The fourth project is a highway link between Brooklyn and Queens. Shown in the lower right corner, the new route would start near the exits from the lower bridges in Brooklyn, pass around the Navy Yard (blocked out for military reasons) to the approaches to Manhattan Bridge and on to connect with the main highway to the borough of Queens. It would have six lanes for express traffic separated for most of its length from service roads and with all but major intersecting streets closed to cross movement of traffic. Construction would cost $5,100,000 and land $7,000,000.

All projects covered by the report can be built in or within a year if design and construction are carried forward on a three-shift basis, according to Moses. A fifth project, the cross-town connection between the Lincoln Tunnel and the new Queens-Midtown Tunnel was not included because of the time element and high cost.

Structures f
project be



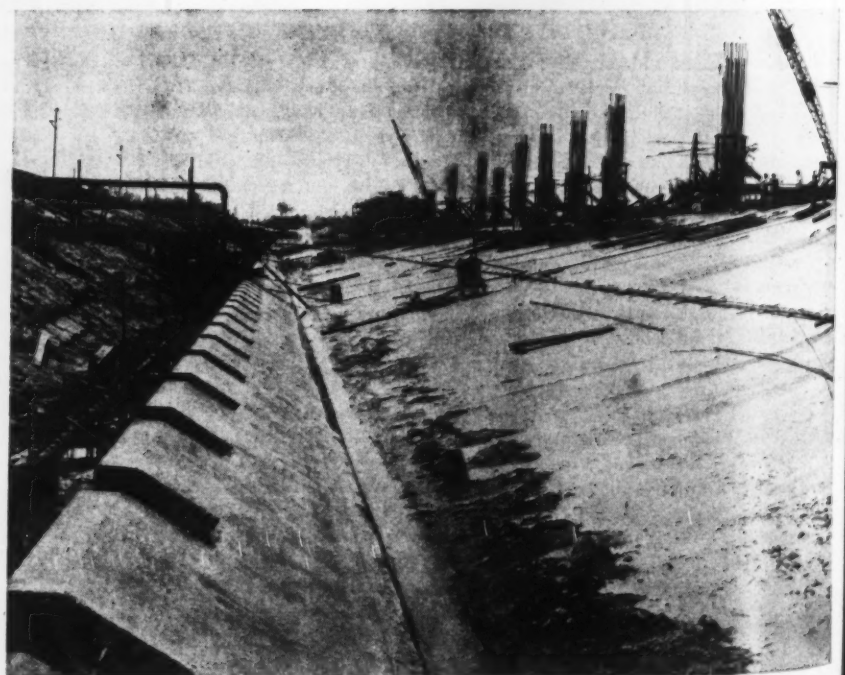
THE POWERHOUSE, navigation lock and two dams for the Santee-Cooper power and navigation project in South Carolina are rapidly rising above their foundations.

The Santee-Cooper work consists of Santee Dam, which includes 7.1 miles of earth fill and 3,400 ft. of concrete spillway on the Santee River; a diversion canal to the valley of the Cooper River; Pinopolis Dam, which is an earthfill 2.1 miles containing the navigation lock and the powerhouse; many miles of earth dikes around the Pinopolis reservoir and a tailrace canal 4.5 miles long to the Cooper River (*ENR* May 23, 1940, p. 706).

Work was begun on the project in 1939 but did not get into full swing until early this year. The condition of work on the lock, powerhouse and spillway dam at the end of the summer is shown in the accompanying photographs. Good progress is being made on the 4.3-mile long hydraulic fill that will make up the major part of Santee Dam. Pinopolis Dam is well along toward completion and excavation of the diversion channel is in progress. The dikes around Pinopolis reservoir are about completed.

Diversion of part of the flow of the Santee River over into the Cooper River valley will permit revival of

LOCK at Pinopolis Dam will have the highest lift of any lock in the world, 75 ft. Its chamber, however, is not large, 60x183 ft., being designed chiefly for barge traffic. The minimum depth over the upper sill will be 12 ft.



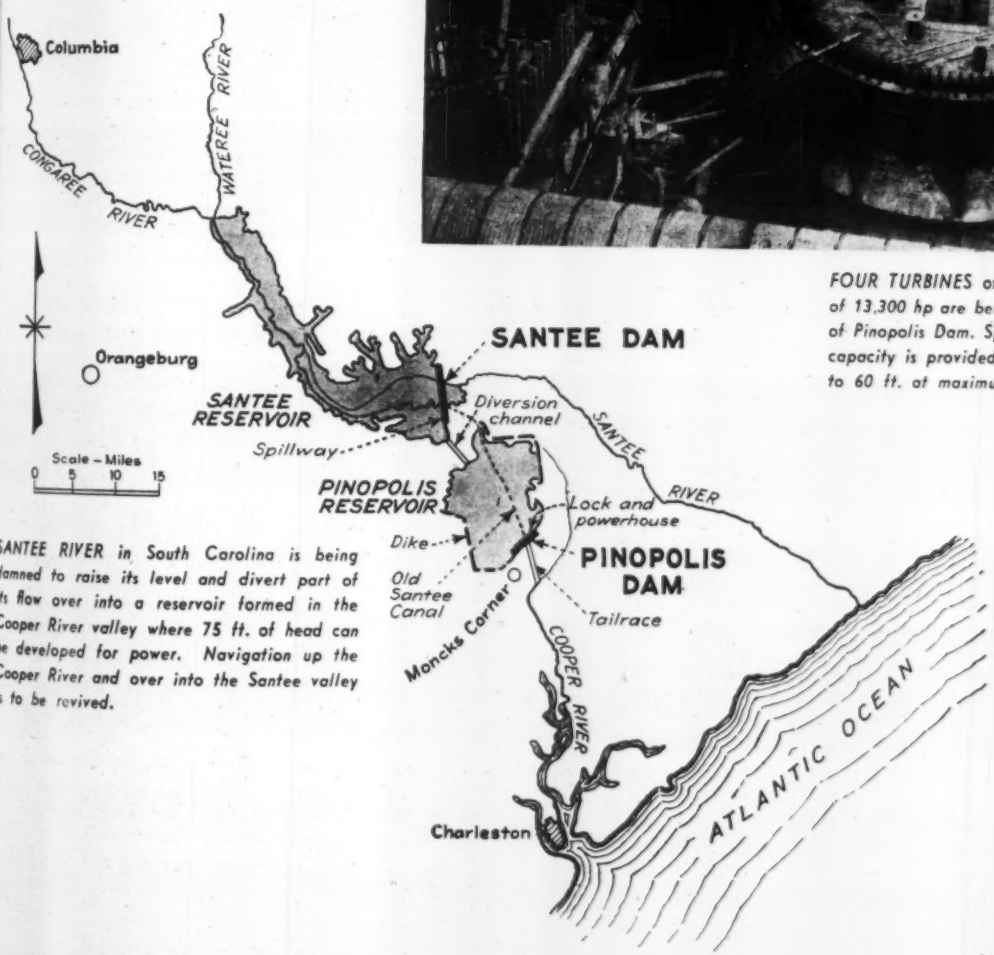
APRON of the 3,400 ft. spillway of Santee Dam is designed to dissipate the energy of a flow of over 400,000 cfs. Openings in apron lip at the left will be filled by training walls and drainage outlets. Reinforcing at the right is for buttresses of the hollow dam which will carry crest gates.

ntee-Cooper take form

navigation from Charleston up the Cooper River into the Santee River valley and on up the Congaree River to Columbia, following roughly the route of an old canal built 150 years ago and abandoned in 1851.

The Santee-Cooper project is being built by the South Carolina Public Service Authority with F. R. Sweeny chief engineer. The Harza Engineering Co. is in charge of the engineering work. The principal construction contracts are held by the Central Engineering Co.; W. C. Shepherd; Wilbanks & Pierce, Inc.; McCarthy Improvement Co.; C. G. Fuller and J. G. Britton; J. A. Terteling & Sons; Virginia Bridge Co. Turbines and generators are being built by Newport News Shipbuilding & Drydock Co., Allis-Chalmers, Westinghouse, and General Electric.

FOUR TURBINES of 40,000 hp capacity and one of 13,300 hp are being installed in the powerhouse of Pinopolis Dam. Space for a fifth unit of 40,000 capacity is provided. The head ranges from 75 ft. to 60 ft. at maximum drawdown of the reservoir.



SANTEE RIVER in South Carolina is being damned to raise its level and divert part of its flow over into a reservoir formed in the Cooper River valley where 75 ft. of head can be developed for power. Navigation up the Cooper River and over into the Santee valley is to be revived.

MEN AND JOBS

B. E. MITCHELL, road designer of the South Dakota State Highway Commission, has been promoted to state manager of the South Dakota Statewide Highway Planning Survey. He replaces HARRY H. MOLE, who recently was called to active duty with the U. S. Engineers.

RALPH O'NEILL, civil engineer, has been transferred from the South Dakota Planning Survey to the South Dakota State Highway Department to be employed on bridge design. W. D. BOWERS, formerly with the Highway Planning Survey of Connecticut, will take over O'Neill's old duties.

COMDR. C. H. COTTER in charge for the Navy on the Jacksonville, Fla. airbase work, has been given additional duties in supervising the establishment of a naval reserve aviation field at Atlanta, Ga. He will also take part in the drafting of plans for similar fields at New Orleans and Dallas.

LESSLIE R. THOMSON, consulting engineer of Montreal, and secretary of the department of munitions and supply at Ottawa, Ont. since the department's formation, has been appointed associate economic adviser to the department. He is succeeded as acting secretary by Q. H. TURNBULL of Montreal.

L. H. FRICK, assistant superintendent of the Los Angeles city construction bureau for many years, has been named superintendent following the retirement of his former chief, C. O. BRITTAIN. He will also serve as city building custodian to be in charge of maintenance of the city's many structures.

WALTER W. COOPER, utility consultant of Berkeley, Calif., has been named city manager of San Diego, Cal. to succeed FRED RHODES, during the past 16 months city manager and public works director. Rhodes will continue the duties of public works director, sudden expansion of municipal and private building work in San Diego making separation of the two offices advisable. Cooper will retain his duties as consultant on utilities to the cities of Oakland, Long Beach and San Diego, and the League of California Cities.

EDWIN E. ABBOTT, since 1933 stationed at the Rock Island District office of the U. S. Engineers as head of the main construction and design office, recently sailed from New York for Panama, where he will be principal engineer on design in connection with the third set of locks for the Panama Canal. Abbott, following his graduation from the University of Kentucky in 1926, was employed in the Louisville, Ky. district of the U. S. Engineers and in the Upper Mississippi Valley division office, St. Louis, before going to Rock Island. In the fall of 1939 he served as a member of an engineering party engaged in a three-months study of the possibilities of the construction of a barge canal across Nicaragua (*ENR* Aug. 17, 1939, p. 197).

NEWLIN D. MORGAN, JR., former structural designer with the New Mexico State Highway Department, has been assigned to act as assistant to the constructing quartermaster for San Antonio, Tex. and vicinity. Morgan is a member of the 461st Engineers Battalion of the Officers Reserve Corps and has been assigned to a year's active duty. In his new work he will aid in the designing, detailing and construction of the Army's building program within a radius of 300 miles of Fort Sam Houston, his headquarters. Before joining the New Mexico State Highway Department, he worked with the Wyoming State Highway Department.

ANDY F. SMITH, office engineer for the district WPA office at Pierre, S. D., has resigned to join the Hawaii Dredging Co. to work at Midway Island, T. H. He will act as surveyman in connection with the construction of a naval base at that point. Smith was with the South Dakota State Highway Commission from 1933 to 1937.

WAYNE OLSEN, with the South Dakota State Highway Commission since his graduation from South Dakota State College in 1935, has been appointed electrical engineer in the industrial department of the Planning Division at the Navy Yard, Puget Sound, Wash.

LEWIS H. KESSLER, member of the hydraulic and sanitary engineering teaching staff at the University of Wisconsin, has been appointed to fill the vacancy in the Madison, Wis. metropolitan sewerage commission left by the recent death of Charles V. Seastone.

CHARLES D. CURRAN has begun new duties as budget examiner, Bureau of the Budget, Executive Office of the President, Washington, D. C. Previously he had worked as engineer, River and Harbor Section, office of the Chief of Engineers, U. S. Army, Washington. Following graduation from the U. S. Military Academy in 1928, Curran was commissioned lieutenant in the Corps of Engineers. He then worked as assistant to the district engineer at Wilmington, N. C., on a Nicaragua Canal survey, at the U. S. Waterways Experiment Station at Vicksburg, Miss., with the Civil Conservation Corps, and with engineer troops in the United States and the Panama Canal Zone. He retired from active military duty in 1935 to work as associate civilian engineer in the hydraulic section, U. S. Engineer Office at New York City, as assistant district engineer on the Pennsylvania flood control bureau, as associate engineer with the Baltimore, Md. U. S. Engineer office, and as engineer in the office of the Chief of Engineers, Washington, D. C. In his new position he will engage in budget examination of War Department activities.

HAL G. SOURS, assistant director of the Ohio State Highway Department, has been named acting director to take over the old duties of ROBERT S. BEIGHTLER, former state highway director who has begun a year's active training at Camp Shelby in Mississippi (*ENR*, Oct. 24, 1940, p. 174). Sours, who received his engineering education at Akron University, has served as maintenance engineer in Summit County for the state highway department and as county engineer of Summit County, and for a time worked with the Truscon division of Republic Steel as a consulting engineer.

P. W. PATTERSON, chief administrative assistant in the Huntington, W. Va. district office of the U. S. Engineers, has been transferred to Washington, D. C. to begin similar duties with the River and Harbors Commission. Patterson was stationed at Zanesville, Ohio from 1934 until 1939 on the construction of the Muskingum watershed conservancy flood control program. He was transferred from Zanesville to Huntington.

C. T. LAIDLAW, a graduate of Queen's University, Kingston, Ont., has been appointed city engineer of Sarnia, Ont. to succeed ANGUS SMITH. Laidlaw had worked with the Ontario Department of Highways at London, Ont.

A. B. FERGUSON, a graduate of the University of Oxford, has been appointed engineer of construction for the Canadian National R. R. at Montreal to succeed the late C. S. Gzowski.

KARL A. SINCLAIR, former PWA administrator for Hawaii, has begun new duties as maintenance engineer with the department of public works at Hawaii, according to DAN BALCH, superintendent of public works for Honolulu. Sinclair will work on a highway program making use of $445,000 in federal aid funds.

JOBS OF THE WEEK

DREDGING AND MOORING, Guantanamo, Cuba

Frederick Snare Corp., New York, N. Y. received a $4,392,000 contract for the dredging and mooring facilities, and a $642,280 contract for 500 housing units at Guantanamo, Cuba. Bureau of Yards & Docks, Navy Department, Washington, D. C. awarded the contracts on a cost-plus-fixed-fee basis.

TOLL BRIDGE, Missouri and Illinois

Massman Construction Co., Kansas City, Mo. was awarded a $1,836,266 contract for constructing a toll bridge across the Mississippi River south of Jefferson Barracks, Mo. St. Louis County, Missouri, is the owner; Sverdrup & Parcel, St. Louis, Mo. are engineers.

TEMPORARY HOUSING, Fort Riley, Kan.

Manhattan Construction Co., Manhattan, Kan.; Long Construction Co., Kansas City, Mo.; and M. W. Watson, Topeka, Kan., will construct the temporary housing at Fort Riley for Construction Quartermaster under terms of a $4,028,800 contract.

GRADE CROSSING, Rockaway, N. Y.

Charles F. Vachris, Inc., Brooklyn, N. Y. was awarded a $2,799,919 contract by the Transit Commission, New York, and the Long Island R. R., New York, for the Rockaway Beach grade crossing elimination project from Beach 54th St. to Mott Ave. The owners also awarded a $1,197,512 contract to Arthur A. Johnson Corp. and Necaro Co., Inc., Long Island City, N. Y., for constructing a subway along Atlantic Ave. from Georgia to Schenck Aves.

POWER PLANT, California

Pacific Telephone & Telegraph Co., San Francisco, Calif., will construct with its own forces a power plant at Dutch Flat on Bear River for generating 28,000 hp. The work is estimated to cost $3,210,000.

SYNTHETIC AMMONIA PLANT, Muscle Shoals, Ala.

Tennessee Valley Authority, Knoxville, Tenn., is constructing a synthetic ammonia plant and reconditioning the ammonium nitrate-manufacturing part of existing Plant 2 at Wilson Dam. The work, being done with its own forces, is estimated to cost $6,217,000.

SHELL LOADING PLANT, Burlington, Iowa

Day & Zimmerman, Inc., Philadelphia, Pa. received a $34,451,384 contract from War Department to design and construct and install equipment for a shell loading plant. Once the plant is complete, Day & Zimmerman will also operate it.

STEEL MILLS, Middletown, O.

American Rolling Mill Co., Middletown, O., awarded a contract for a 54-in. cold reduction mill to Mesta Machine Co., Pittsburgh, Pa. and a contract for a soaking pit at the same plant to Surface Combustion Corp., Toledo. Total estimated cost of the plant is $3,800,000. American Rolling also awarded a contract for 25 byproduct coke ovens for a plant at Hamilton, O. to Koppers Co., Pittsburgh, Pa. Total estimated cost of this plant is $1,500,000.

HOSPITAL, Canal Zone.

MacDonald Construction Co., St. Louis, Mo. received a $4,115,000 contract for two hospitals and a nurses home at Fort Clayton and Fort Gulick, Canal Zone. Construction Quartermaster, New York, awarded the contracts.

AMMUNITION LOADING PLANT, Union Center, Ind.

Bates & Rogers Construction Co., Chicago, Ill. will construct an ammunition loading plant for the War Department under terms of a $11,500,000 contract awarded on a cost-plus basis. Giffels & Vallet, Inc., Detroit, Mich. are architects for the project; C. W. Cole, South Bend, is engineer.

ARMY CONCENTRATION CAMP, Rolla, Mo.

C. F. Lytle Co., Klinger Construction Co., and Hubert Everist Co., all of Sioux City, Ia., and Arthur Newmann Co., Des Moines, Ia., were awarded a joint $8,428,670 contract for constructing an army concentration camp. Alvord, Burdick & Howson, Chicago, are engineers for the project, which was reported Oct. 24 in "Jobs of the Week" with Leon, Ia. the site. However, because of a possible water shortage at that location the camp was changed to Rolla, Mo.

MILITARY POST, Rockford, Ill.

John Griffith & Sons, Chicago, Ill., received the contract for constructing the military post at Camp Grant for the Constructing Quartermaster, Washington, D. C. Holabird & Root, Chicago, Ill. are architects for the work, which is estimated to cost $4,000,000.

NOTE—Additional bidding and contract news on over 800 projects large and small, appear in the Construction News Section beginning on page 14.

Wide World photo

Michigan's new governor

Murray D. Van Wagoner, state highway commissioner of Michigan, was elected governor of that state in the Nov. 5 election by a majority of about 100,000 votes. Van Wagoner, who received a civil engineering degree from the University of Michigan in 1921, was president last year of the American Road Builders Association. Following graduation he was employed by the Michigan State Highway Department as resident construction engineer and division bridge engineer with headquarters at Alpena. Later he organized his own private engineering office in Pontiac, Mich., continuing in private work for seven years. In 1930 he was elected commissioner of Oakland County, Mich., and in 1933 at the age of 35, state highway commissioner.

Alabama tax does not affect some defense jobs

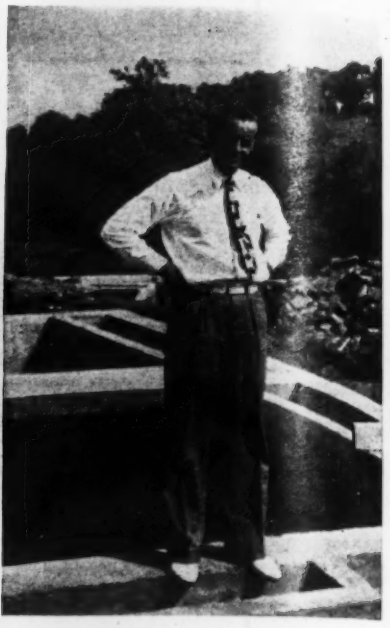
Attorney General Lawson of Alabama has ruled that that state is not entitled to collect a 2-percent sales tax from contractors holding cost-plus contracts for federal work in Alabama as part of the defense program. In such cases Lawson held that the contractor is in effect a purchasing agent for the federal government.

The attorney general pointed out that, since the question would arise in several states and would likely be carried to the U. S. Supreme Court, "that a plan be effectuated whereby the contractors will not be required to pay the sales tax at this time and will not be penalized in any way for this failure to do so, with the understanding that when the legal question is finally determined, payment will be made by said contractors, if required."

The ruling was handed down at the request of Hodgson Construction Co. of Montgomery, Ala., which holds a contract for work at Camp McClellan, near Anniston, Ala.

MEN AT WORK

Completing a quarter century of service with the Los Angeles department of water and power DEAN VAN NORMAN (center above) gets a 25-year pin from his brother H. A. VAN NORMAN, head of the water department and winner of a similar pin in 1932. CLAUDE VAN NORMAN, another brother who received such an award in 1934, and is now retired, looks on.



As WPA superintendent in the Erlanger, Ky., area JOE CAMPBELL, formerly with Firestone Plantations Co. in Liberia, has plenty of varied duties. He is shown on one job that calls for construction of a 290,000-gal. sewage treatment plant and 17 miles of sewer. He is a graduate of the University of Kentucky.

SHERWOOD J. STACY, for 13 years with the Wyoming State Highway Department, was not headed for a round-up but for Panama when the photo below was taken. Stacy recently began new duties as assistant engineer technician on soils in the Canal Zone.

Operation of the new Springfield, Mass., sewage disposal plant—the finest in New England, they say—has been placed in the hands of WILLIAM WOODWARD, chemist, and JOHN McDONALD, superintendent. McDonald was on the job as construction engineer when the first spade of dirt was turned.

On the new 18-mile, 4-lane, divided highway from Elkton, Md. to the new Havre de Grace bridge the editor found the group above hard at work. They are, left to right: T. G. MOHLER, chief of a survey party; J. O. RIDGEL, engineer for Maryland State Roads Commission, and J. W. BROSTUS, superintendent for the contractor, M. J. Grove Lime Co., Lime Kiln, Md.

Sugar plantation work in Santa Domingo, jetty construction in Colombia, railway locating in Persia, and highway building in Russia, besides several years varied work in the U. S., was the record of J. H. MOORE (above) when he joined PWA in 1933. Since then he has worked in the central office as examiner, as chief engineer in the South Carolina state office, principal engineer in the Atlanta, Ga., regional office, and for the past two years as assistant project engineer on the Santee-Cooper work.

On the 30-in. intake being built to bring Lake Michigan water to Muskegon Heights, Mich., only a personal inspection would satisfy F. E. FULMER (right), resident engineer for Greeley & Hansen, Chicago consultants for the work. Using a diver's suit was not a new experience for Fulmer for he had a similar assignment on the Sandusky, Ohio job.

As assistant engineer for the Charleston County, S. C. sanitary and drainage commission, JULIAN B. WESTON describes with map benefits of a Charleston County road project. Weston, a graduate of the Citadel in 1921 with a degree in civil engineering, joined the commission in 1925. Prior to that he was with the South Carolina State Highway Department.

JAMES BURKE (below), who served as resident construction engineer on the $1,500,000 sewage disposal works at Springfield, Mass., for White & Burke, Springfield, makes a final check of the equipment before the plant goes into operation.

Tacoma Span Wrecked

(Continued from p. 1)

dence of movement in the saddles in the course of the violent bouncing. The piers are believed to be undamaged.

Tacoma Narrows Bridge, third longest suspension span in existence (Golden Gate 4,200 ft., George Washington 3,500 ft., Tacoma Narrows 2,800 ft.) was built between October, 1938, and July, 1940, and was opened to traffic in July. It was by far the most slender suspension bridge ever built, both laterally and vertically, the width of the roadway and spacing of cables being only 39 ft. (span ratio 1:72), and the depth of the stiffening girders 8 ft. (span ratio 1:350).

In general conception it followed the model set by the Whitestone Bridge (span 2,300 ft.), but was longer in span and much narrower. To suit the expected traffic it was built for only two traffic lanes against six on Whitestone and Golden Gate and an ultimate of twelve on the George Washington Bridge.

Wave motion studied

The destructive wave movements that wrecked the bridge were the sequel to a history of disturbing oscillation that had been under observation and study since the bridge was built. Similar but much smaller oscillation occurs on the Whitestone Bridge, but while there it amounts to only a few inches, the vertical waves in the Tacoma Bridge were very much greater, having reached as much as 50 in. amplitude.

Various means were tried to check the movement, and elaborate model experiments were conducted, those for Whitestone by Prof. E. K. Timby at Princeton University and those for Tacoma Narrows by Prof. F. B. Farquharson at the University of Washington. The Tacoma Narrows model, 54 ft. long, is a precise scale representation of the bridge in 1:100 ratio and is fitted with a series of electromagnets to apply horizontal and vertical forces simulating the effect of wind pressures. It was found that the behavior of the actual bridge could be duplicated with great accuracy, and various corrective arrangements and devices were tried out.

Tie ropes reduced movement

In the Whitestone Bridge, short inclined rope ties were placed between midpoints of the main cables and the top flanges of the stiffening girders to hold the bridge deck from moving longitudinally with respect to the cables and friction brakes were placed at the connection of bridge deck and towers to damp any longitudinal movement; these provisions reduced the vertical oscillation materially.

At Tacoma Narrows one control method applied, after proving effective on the model, was to tie down a point in each side span to the ground below. Such tie was provided on the bridge in the form of 1⅛-in. cables extending from the deck of the side spans to 50-yd. concrete anchors on the ground below, at points 300 ft. out from the anchorages. These ropes broke three or four weeks ago during a moderate blow. Diagonal ties from the tower tops to the stiffening girders were considered but not tried.

Streamlining found effective

Recent work with the big Tacoma Narrows Bridge model and with smaller models exposed in a wind tunnel was directed to determining whether the form of the stiffening member contributed to the oscillation trouble, and to trying out the effect of various shielding or streamlining fascia arrangements along the sides of the girders. Proper streamlining almost completely suppressed the disturbing wind effects, it was found. Application of these experimental findings to the bridge had not been possible at the time of the accident.

Prior to Nov. 7 such vertical waves as had occurred never got out of step on opposite sides and no damage was done, although at times smooth uniform waves with as much as 50-in. amplitude were observed.

Ten different wave periods had been observed on a 1:100 model in the University of Washington laboratory, and on the bridge itself, observed perhaps more frequently than others, was the 12-second period, the same as the period of the towers.

In the various waves it had been noted that the midspan was subjected to the least vertical movement and, presumably, to the maximum of flexure. It was here, most witnesses say, that the first structural failure occurred.

Supporting the theory that the stiffening girders were the first to fail, is a picture that shows a decided disalignment of these girders at midspan (possibly a kink or a shear rupture) at a time when the concrete roadway can be seen to be still intact. Another picture, taken soon after the first concrete fell out, shows a pair of diagonals of the lateral system broken loose and hanging below the floor system.

Eyewitness account

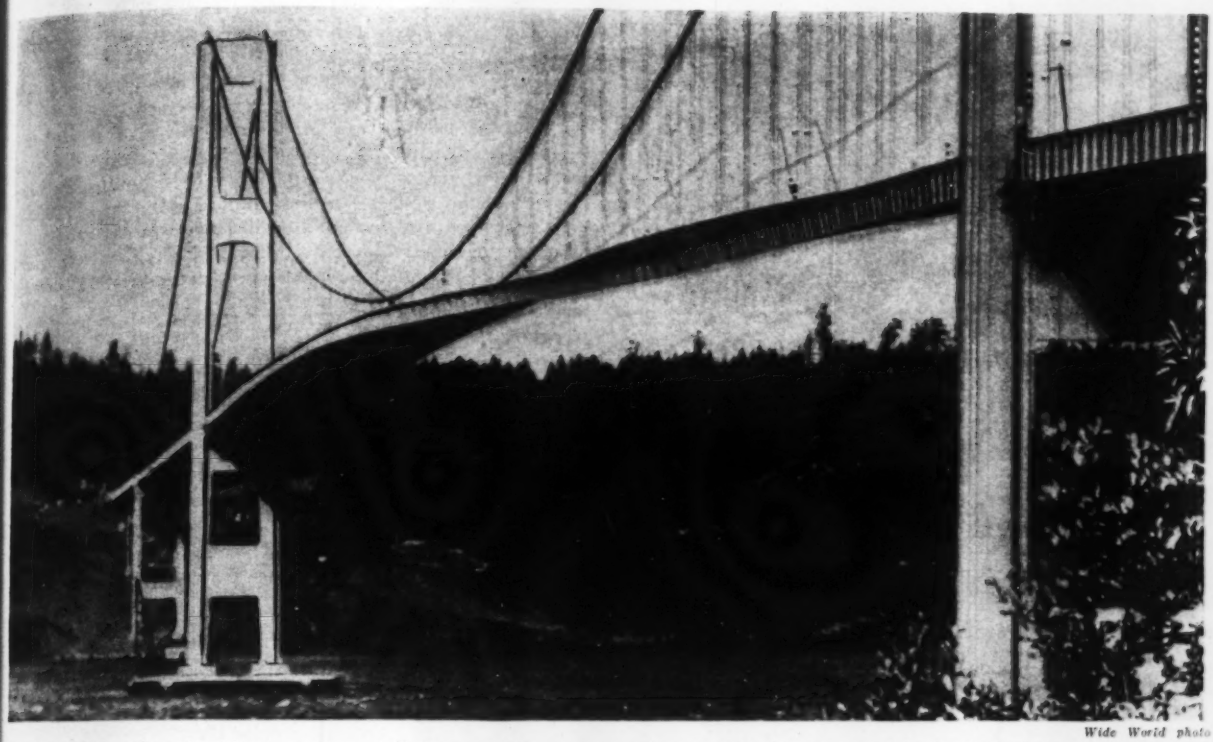
F. B. Farquharson, associate professor of civil engineering, University of Washington, who directed the model studies and is familiar with the traits of the bridge, was on it as the destructive wave motion built up. He reports that the deck tilted from side to side more than 45 deg., that the edges of the deck had an up-and-down movment of 28 ft., and that the acceleration in the movement of the deck at times exceeded that of gravity.

Conditions observed in the collapse support the theory, reached about a

(Continued on p. 12)

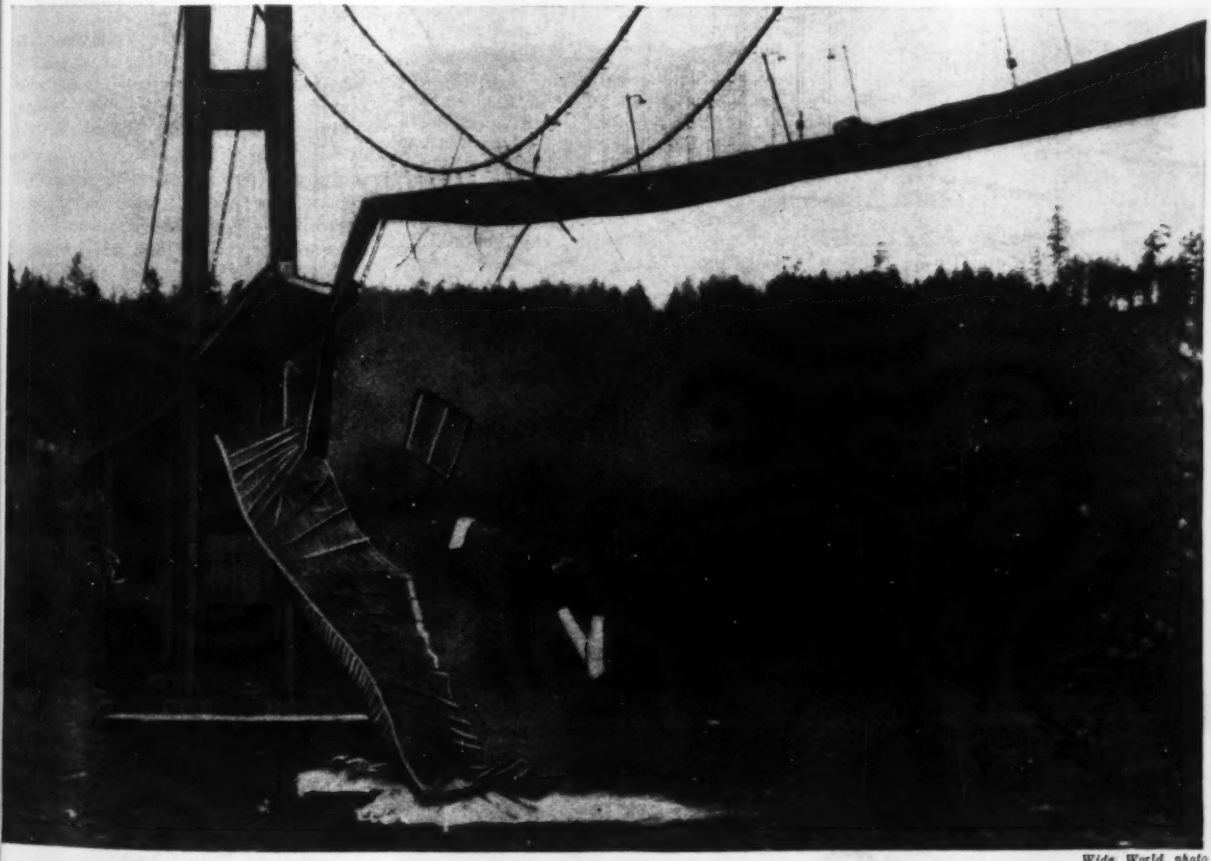
Douglas Fir Plywood Association photo

With the load of the central span released, the sagging 1,100-ft. side spans still hold, though the towers are bent back sharply. The side-span decks now are being removed.



Wide World photo

A minute or two before its fall, the roadway of the Narrows Bridge heaves, rocks and twists violently enough to break off the lamp standards.



Wide World photo

A six-hundred-foot length of the roadway tears from its suspenders and turns over in falling to the waters of Puget Sound below.

Tacoma Span Wrecked

(*Continued from p. 10*)

month ago, that the cause of the vertical waves was aerodynamic instability of the floor system. A 1:20 model of a section of the floor system, tested in the wind tunnel at the University of Washington, was found to have unstable characteristics that fully account for the wave movement. This test was followed by studies looking to remedial measures. These had been developed and a contract for their installation on the bridge was under negotiation when the collapse occurred.

The remedy is extremely simple, consisting of a deflector vane that changes aerodynamic characteristics in such a way as to prevent the continual reversal of vertical components of wind forces. Unchecked, these forces build up cumulative wave motion which, after a considerable weight of bridge deck is involved, accumulate destructive energy.

Bridge to be rebuilt

Prospects are for immediate reconstruction of the bridge if the condition of towers and cables justifies. Removal of the floor of the side spans is now in progress, and final decision on whether the cables and towers will have to be dismantled must await completion of this work and inspection after the unloading. The bridge was insured, so that there will be small if any loss to the state and the federal financing authorities.

Who built the bridge

Tacoma Narrows Bridge is a state-owned structure built with federal funds by the Washington Toll Bridge Authority, an agency of the state of Washington, as a toll-refunding structure. It cost $6,400,000. A grant of $2,880,000 was made by the Public Works Administration and a loan of $3,520,000 was provided by the Reconstruction Finance Corp. The design was prepared by the well known suspension-bridge authority, Leon S. Moisseiff, consulting engineer, New York, in cooperation with the staff of the Washington Toll Bridge Authority (L. V. Murrow, chief engineer, Clark H. Eldridge, bridge engineer, and Charles E. Andrew, principal consulting engineer). The superstructure was fabricated and built by the Bethlehem Steel Co., cable wire and suspender ropes being made by John A. Roebling Sons Co. The deep open dredging piers of the main towers were constructed by Pacific Bridge Co., San Francisco, General Construction Co., Seattle, and Columbia Constructing Co., Bonneville, Ore., as general contractors for the entire undertaking.

• • •

Ogoki diversion work authorized by Ontario

Diversion of waters from the Hudson Bay drainage basin over into the Great Lakes basin for power development has been authorized by the government of Ontario. Use of this water for power development in Canada was the subject of a recent temporary agreement between the governments of Canada and the United States relating to power for war purposes (*ENR*, Oct. 17, p. 508).

The Hydro-Electric Power Commission of Ontario has been authorized to build a dam and control work on the Ogoki River and to cut a diversion channel through to one of the streams flowing south into Lake Nipigon from where the diverted water will flow into Lake Superior. Cost of the work is estimated at $12,000,000.

The commission also has been authorized to start development of power on the Madawaska River, a tributary of the Ottawa River. A storage dam costing $1,700,000 is to be built on the headwaters at Bark Lake and a 54,000-hp plant is to be built at Barrett Chute at a cost of $5,300,000. The river has a potential power capacity of 200,000 hp.

• • •

Somervell recalled to army engineer service

Lieut. Col. Brehon B. Somervell, head of the large Works Projects Administration in New York City since August, 1936, has been recalled to service with the Corps of Engineers, U. S. Army. In the four years that Somervell has headed the WPA work in New York City nearly one billion dollars have been spent under his direction, the efficiency of the organization has been greatly improved, and administrative costs have been drastically cut.

• • •

Federal permit required for N. C. power project

The Federal Power Commission has ruled that a federal license is necessary for construction for the Fontana hydroelectric project proposed for western North Carolina by the Nantahala Power & Light Co., Franklin, N. C., because the project would affect interstate commerce. The project would be built on the Little Tennessee River and would have a dam 470 ft. high and a reservoir with a storage capacity of over 1,000,000 acre-ft. Plans call for four units with a capacity of 300,000 hp.

• • •

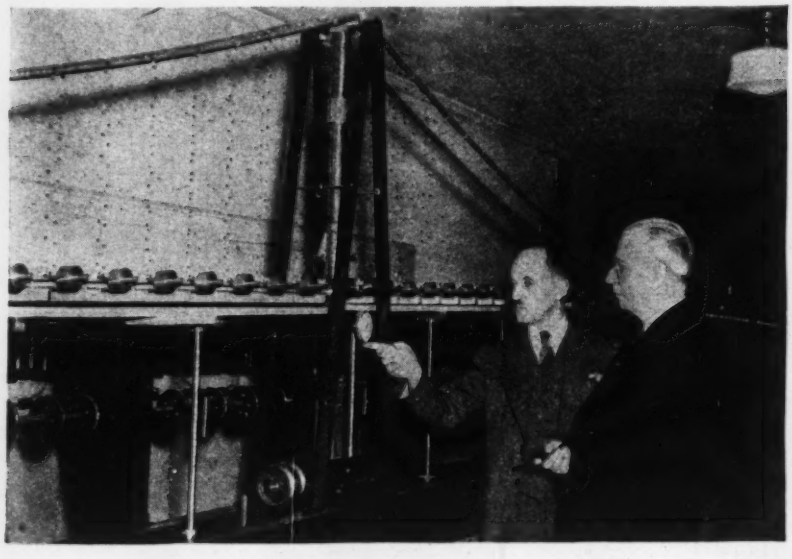
N. Y. Engineers approve wage-hour classification

The New York State Society of Professional Engineers at its fall convention at Jamestown last month passed a resolution approving the definition of the term "professional capacity" by Col. Philip D. Fleming, administrator of the wage-hour division of the Department of Labor (*ENR*, Oct. 17, 1940, p. 504).

• • •

Baltimore approves big loan for sewer work

At the Nov. 5 election, Baltimore voters approved a $5,000,000 loan for sewerage improvement. At the same time, a plan for an equal loan for street improvements project was voted down.



Attempts were made to control the oscillations of the Tacoma Narrows Bridge by aid of tests on a 1:100 model set up at the University of Washington.

WASHINGTON HIGHLIGHTS

THE LONG-AWAITED Public Roads Administration report on defense highways will be completed this month, it is now hoped. Hold-up has been the necessity for continual change in the plans to keep it in step with the developing program of the Army. Chief effect of these changes has been greatly to emphasize the access road phase of the program, which now far exceeds the figures announced in September (*ENR* Sept. 12, p. 323).

As soon as the report is completed it is expected that a request will go to Congress for money to build access roads as few of such roads have any value except for military purposes. Under the circumstances neither state nor local authorities are willing to put money into roads that may be abandoned in a few years.

A STUDY of the best methods of protecting oil storage and pipeline facilities against attack and sabotage has been initiated by the American Petroleum Institute at the request of the Defense Commission. A regional organization is being set up to work with local Army and Navy representatives. The studies are not expected to result in any recommendation of wholesale construction of underground storage. Major attention will be given to such questions as firewalls, extinguisher systems, and the like, with emphasis on the desirability of comparatively isolated locations. However, the commission feels that where it proves necessary to build new storage facilities in congested areas with high land values, underground storage might result in enough economy of land so that it would cost only a little more than overground tanks.

ATTEMPTS to halt the activities of "Washington agents" who represent themselves as able to obtain contracts for their clients were made last week by the Quartermaster Corps and the Public Buildings Administration. Each agency sent form letters to all contractors on its lists, saying that negotiated contracts are being awarded strictly on the merits of the contractors, pointing out that contingent contracts with such agents are illegal, and reminding contractors that the forms of contract being used contain a specific warranty that no commission or contingent fee is being paid anyone for obtaining the contract.

These letters, which follow previous similar warnings, were sent partly at the instance of leaders of the construction industry, who are worried about the effect on public opinion of the activity of such men. Sometime in the future, they feel, there are bound to be investigations of the negotiated contracts now being awarded. No matter how clean the record may be, a bad impression will be created by the fact that, for instance, one agent is circulating a promotional letter claiming that a client of his has just received a million-dollar contract and that the events leading up to the award make "a very interesting story."

Several dozen such agents are believed to be operating in Washington and in some cases they appear to be obtaining fairly substantial sums from would-be government contractors.

• • •

Texas oil firms must stop river pollution

A final judgment restraining eleven East Texas oil companies from polluting the Neches River with salt water has been entered for Attorney General Mann and the state of Texas by a judge in the 116th District Court at Dallas, Tex. The court overruled the motion for a new trial. Attorneys for the defendant companies have filed notice of appeal.

The order restrains defendants from pumping salt water directly or indirectly into natural streams or using evaporation pits that allow the mineral waste to seep through the ground into underground water supplies.

• • •

Alabama's only toll span made free for public use

The only toll bridge in the state of Alabama, that across the Tennessee River between Florence and Sheffield, was made free for public use in the Nov. 5 general election. At that time an amendment to the state constitution was passed allowing $900,000 of general obligation bonds to be issued to take up bonds issued by the Alabama Bridge Commission.

Placing of 122,700,000 cu. yd. for Ft. Peck Dam completed

Fort Peck Dam on the Missouri River in eastern Montana was topped out Oct. 11 when J. A. Terteling & Sons completed their contract for placing dry fill in the upper part of the structure. Final yardage figures for the dam, as determined by the U. S. Engineers, which built the project, are 122,700,000 cu. yd. of fill. All but 540,000 cu. yd. of the total was placed by hydraulic methods. Since last April Terteling has moved 1,400,000 cu. yd. of sand from the downstream face and 69,000 cu. yd. of glacial fill from the west abutment onto the top of the dam.

The above view shows the dam as it now stands, 250.5 ft. above original river bed. The downstream (right) face has been roughened by listing into furrows 14 in. wide and 10 in. deep, 3 ft. apart to prevent surface erosion. This treatment takes the place of seeding originally planned. Work is still under way on placement of gravel blanket and stone riprap on the upstream face, construction of a power house at the outlet of No. 1 diversion tunnel, and installation of control machinery at Tunnel No. 4.

Lieut. Col. C. N. Iry is district engineer in charge of the $122,900,000 project, which is for power, navigation, and flood control.

OBITUARY

ROBERT B. RICHARDSON, 60, civil engineer of the Tennessee Powder Co., and stationed near Millington, Tenn., died last week. Before going to Tennessee, he was assistant state supervisor of the Mississippi Planning Commission, being stationed at Greenville, Miss. For ten years he was with the U. S. Engineers at West Memphis.

ROY W. HEATH, city engineer and a member of the city planning commission of Fond du Lac, Wisc., died Oct. 29 at the age of 57. Prior to his appointment as city engineer in May 1937, Heath had been engineer for the city on a WPA project for two years.

FRANZ RADLOFF, 82, prominent builder and paving contractor of Plymouth, Wisc., died Nov. 3.

CHARLES P. MC LAUGHLIN, 72, for 28 years chief engineer of the city waterworks at Zanesville, O., died in that city Nov. 3. For three years he was examiner engineer for the state of Ohio. He retired two years ago.

EDWARD G. MAJOR, 60, civil engineer of Akron, O., died Nov. 5.

NEVIN R. DICKSON, 66, city engineer in Corry, Pa., for the past 40 years, died Nov. 3 in that city.

EDWARD J. OWENS, 46, member of the engineering staff of the New Brunswick Electric Power Commission and an engineering graduate of the University of New Brunswick, died last week. He had been with the commission since 1920.

LEVIN E. PALMER, 64, former president of the Palmer-Spivey Construction Co., died last week at Charlotte, N. C.

CHARLES O. ROGERS, 59, retired building contractor formerly with the firm of Rogers & Leventhal, died Nov. 7 at Chattanooga, Tenn.

WALTER TENNEY SMITH, 68, graduate of Harvard University and formerly assistant engineer of the Metropolitan Elevated Railway of Chicago, died Nov. 11 in Montclair, N. J. From 1913 to 1933 Smith served as vice-president of the George A. Fuller Co., New York.

S. S. TOLER, 73, building contractor, died at Rocky Mount, N. C. Nov. 1.

HARRY I. HOAG, 58, division engineer of the New York Central Railroad in Buffalo, N. Y. since 1935, died Nov. 12.

WILLIAM W. MALLORY, 65, president of the city-owned Memphis Light, Gas and Water Division, died last week in that city. He was head of the utility property when the city purchased it in 1939.

ALFRED S. ALSCHULER, 64, who for many years had his own architectural offices in Chicago, died in that city Nov. 6.

HAROLD C. MC LAUGHLIN, 47, architect of Atlanta, Ga., who served in the construction division of the Army during the World War, died Nov. 3 in Atlanta. During the depression he served as director of personnel for the government land survey for the state of Georgia. Recently he had been employed by Robert & Co. as an architect on one of Atlanta's large housing projects. More recently he had been working in Savannah, Ga., with Burge and Stevens on an Army project. He was a graduate of the University of Missouri and the Massachusetts Institute of Technology.

• • •

Transport ban upheld

The right of the state of West Virginia to bar double-decker automobile transports from the highways of that state was upheld by a three-judge federal court recently. The court sustained a state motion to dismiss an injunction seeking to restrain enforcement of the statute enacted by the 1939 legislature.

CONTRACTS AND CAPITAL

FOR THE FOURTH time in the last five weeks engineering construction awards exceed the $100,000,000 mark. The total for the short week due to the Armistice Day holiday, $139,119,000, tops the volume for the short preceding week by 75 per cent. The current total tops the 1939 week, and this is the 11th consecutive week in which 1940 awards have surpassed their respective 1939 values.

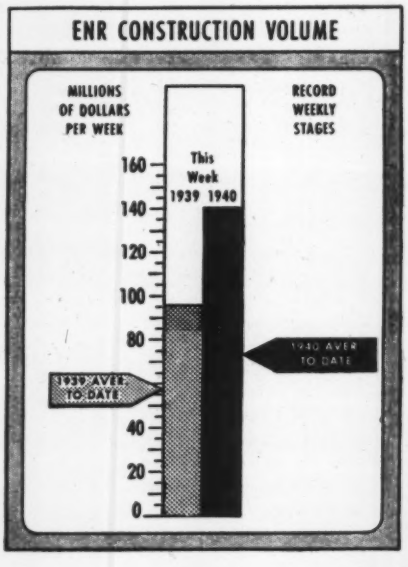
Private awards are 44 per cent above a week ago due to the increase in commercial and industrial building. Public construction is 87 per cent higher as a result of the near-record public building total.

The week's awards bring 1940 construction to $3,424,579,000, 26½ per cent higher than in the 46-week period in 1939. Private work is up 29 per cent, and public construction 25 per cent higher than in 1939 due to a 260 per cent gain in federal awards.

Public building construction, $73,285,000, reached the second highest week of the year as a result of awards for ammunition and shell loading plants, barracks, cantonments and defense housing projects in all parts of the nation.

New capital for construction purposes for the week totals $14,236,000, an increase of 96 per cent over the $7,282,000 reported for the corresponding 1939 week.

New construction financing for 1940 to date, $3,597,029,000 is 58 per cent above the $2,270,549,000 reported for the 46-week period in 1939.



CONTRACTS

(Thousands of dollars)

	Week Ending Nov. 16 1939	Nov. 7 1940	Nov. 14 1940
Federal	$11,149	$34,461	$74,312
State & Municipal	56,478	22,539	32,198
Total public	$67,627	$57,000	$106,510
Total private	28,789	22,645	32,609
TOTALS	$96,416	$79,645	$139,119
Cumulative 1940	(46 weeks)		$3,424,579
1939	(46 weeks)		$2,707,373

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial building, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1939 46 Wks.	1940 46 Wks.
NON-FEDERAL	$1,142,521	$1,315,068
Corp. Securities	196,418	221,794
State & Mun.	457,157	454,788
R.E.A. loans	89,445	40,000
U.S.H.A. loans	201,647	218,704
R.F.C. loans	7,854	195,772
Fed. Aid-Hwy.	190,900	184,000
FEDERAL	$1,128,028	$2,281,961
TOTAL CAPITAL	$2,270,549	$3,597,029

FHA MORTGAGES

	Week Ending Nov. 11 1939	Nov. 2 1940	Nov. 9 1940
Selected for appraisal	$19,216	$18,728	$17,500*
Cumulative 1940	(45 weeks)		$1,126,175*
1939	(45 weeks)		$1,134,665

* Subject to revision.

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Nov., '40	247.24	118.85
Building Cost	Nov., '40	206.24	111.49
Volume	Oct., '40	430	215

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

STREET PAVING OKLAHOMA CITY

OWNER: City of Oklahoma City, Okla.; J. S. Waldrep, city engineer; Fred Cobb, engineer.

PROJECT: Grading, drainage and asphalt pavement on 22 residence blocks. Involves paving 26-ft. width, curbing, gutters, storm sewer inlets, and road-mixed asphaltic concrete surface.

CONDITIONS: All unskilled labor and a portion of the materials to be furnished by the WPA and the job to be done under contract management plan. Owner's portion to be assessed against abutting property owners and paid in special ten year improvement bonds. Contractor not to be paid in cash. First contract of this type to be let in Oklahoma City. Length of contract uncertain as contractor has to depend on WPA for all common labor. Highway and railroad transportation facilities available. Wages stipulated are: skilled labor, $1.00 per hr.; semi-skilled, 60c.; and common labor, 40c. per hr.

BIDS: Four bids were opened June 4, 1940, ranging from contract low of $86,503 to $94,320.

LIST OF BIDDERS:

1. Richards & Mullinix, Inc., Oklahoma City, Okla. (contract) $86,503
2. J. A. Briscoe, Stillwater, Okla 88,410
3. Roy Tanner Paving Co., Tulsa, Okla 90,861
4. Ryan-Beekman Co., Oklahoma City, Okla 94,320

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Asphaltic conc. surface	6,413 tons	$4.13	$4.25	$4.25
2. Gravel base course	14,250 c. y.	1.50	1.55	2.10
3. Conc. curb and gutter	38,922 l. f.	.58	.57	.40
4. Unclassified excavation	36,360 c. y.	.19	.20	.20
5. Concrete header	2,816 l. f.	.36	.34	.35
6. Priming and sprinkling	450 M gal.	10.00	10.50	12.00
7. Native rock masonry	275 c. y.	2.00	2.75	5.00
8. Concrete C. P. mix	81 c. y.	6.25	5.00	6.50
9. Reinforcing steel	7,620 lb.	.06	.065	.05
10. Concrete hand rail	80 l. f.	.80	.85	.90
11. Storm sewer inlets (single)	5 ea.	40.00	35.00	50.00
12. Storm sewer inlets (double)	11 ea.	72.00	85.00	75.00
13. Manhole castings reset to grade	24 ea.	3.20	3.25	5.00
14. Valve boxes reset to grade	20 ea.	1.60	1.70	2.00
15. 18-in. storm sewer pipe	168 l. f.	1.60	1.75	1.50
16. Concrete curb and 3-in. gutter	148 l. f.	.59	.60	.50
17. Relay 48-in. concrete pipe	50 l. f.	1.60	1.70	1.50
18. Concrete curb	966 l. f.	.28	.26	.25
19. 6-in. cl. 150 centri. cast iron water pipe	72 l. f.	2.24	2.25	2.00
20. *¾-in. hvy. brass corporation cocks	7 ea.	1.94	1.70	2.00
21. *¾-in. hvy. brass curb cocks	7 ea.	2.53	2.55	2.00
22. ¾-in. type K copper service pipe	200 l. f.	.34	.35	.25

* Oklahoma City Water Department Standard.

BRIDGES AND HIGHWAY ALABAMA

OWNER: Alabama State Highway Department, Montgomery; Chris J. Sherlock, director.

PROJECT: Grading, drainage, double bituminous surface treatment, bridges, and removal of structures on the Cullomburg-Gilbertown Road, Choctaw County, Ala. Length of projected road 12.395 miles.

CONDITIONS: Contractor to furnish all material and complete work in 280 days; work in connection with bridges to be completed in 160 working days. Highway transportation facilities available. Minimum wage rates specified are: skilled labor, 85c. per hr.; semi-skilled, 40c.; and unskilled labor, 30c. per hr.

BIDS: Six bids were received September 13, 1940 for the road construction portion of the project. They range from $220,015, the contract low, to $243,174. On the bridge construction five bids were opened on the same day, ranging from the contract low of $36,775 to $38,720.

Roadway

LIST OF BIDDERS:

1. Coggin & Deermont, Chipley, Fla. (contract) $220,015
2. Hooper Constr. Co., Jacksonville, Fla. 225,813
3. Mitchell Brothers, Birmingham, Ala. 226,491
4. Noonan Constr. Co., Pensacola, Fla. 228,978
5. Vandigriff Constr. Co., Montgomery, Ala. 230,817
6. W. L. Cobb, Tuscaloosa, Ala. 243,174

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear and grub	L.S.	$7,000.00	$7,500.00	$6,000.00
2. Clear and grub (beyond rt.-of-way)	10 ac.	40.00	40.00	30.00
3. Remove structures	L.S.	1,786.00	3,325.00	2,805.00
4. New materials, etc.	L.S.	150.00	50.00	15.00
5. Remove sidewalk	115 s. y.	.20	.15	.15
6. Remove headwalls	154 ea.	3.00	3.50	3.00
7. Reset fence	95,500 l. f.	.03	.025	.025
8. Common excavation	301,000 c. y.	.20	.19	.21
9. Stripping excavation	5,000 c. y.	.13	.15	.15
10. Unclassified culvert excav.	140 c. y.	1.00	1.25	1.00
11. Overhaul (lc. or less)	333,900 sta. y.	.003	.005	.005
12. Special haul, base	330,050 c. y. ½mi.	.02	.0275	.025
13. Special haul, top	1,000 c. y. ½mi.	.02	.04	.03
14. Roadbed topping	34,050 c. y.	.25	.27	.28
15. Top soil or sand clay base	72,750 c. y.	.32	.37	.35
16. Pit moves	8 ea.	25.00	50.00	10.00
17. Double surface treatment	162,000 s. y.	.23	.235	.229
18. Culvert conc. Cl. A—new	151 c. y.	25.00	23.50	21.00
19. Culvert conc. Cl. A—ext	359 c. y.	27.00	28.50	24.00
20. Headwall conc. Cl. B	154.46 c. y.	27.00	28.00	28.00
21. Reinforcing steel	75,308 lb.	.045	.045	.045
22. 18-in. concrete pipe	1,134 l. f.	1.60	1.65	1.85
23. 24-in. concrete pipe	741 l. f.	2.70	3.00	3.00
24. 30-in. concrete pipe	210 l. f.	3.50	4.00	3.70
25. 24-in. conc. pipe, extra str.	84 l. f.	3.25	4.00	3.50
26. 18-in. conc. pipe, extra	1,308 l. f.	1.70	1.65	1.80
27. 24-in. conc. pipe, extra	426 l. f.	2.80	2.60	2.90
28. 30-in. c. i. pipe—ext.	174 l. f.	10.00	6.50	5.75
29. 18-in. conc. pipe, S.D.	1,537 l. f.	1.25	1.00	1.15*
30. 24-in. conc. pipe, S.D.	377 l. f.	2.00	1.70	1.80*
31. 30-in. corr. metal pipe, S.D.	60 l. f.	2.50	2.90	2.40
32. 6-in. extra quality drain tile underdrain	12,500 l. f.	.80	.70	.65
33. Relay road pipe	570 l. f.	1.00	1.50	1.00
34. Side drain pipe relaid	308 l. f.	.50	1.00	.70
35. Inlets, type 1-A	2 ea.	50.00	75.00	80.00
36. Inlets, type B	6 ea.	60.00	75.00	80.00
37. Inlets, type S	1 ea.	100.00	75.00	80.00
38. Combination curb and gutter	1,000 l. f.	1.00	1.25	1.20
39. Concrete curb	270 l. f.	.50	.80	1.00
40. Concrete sidewa'k	70 s. y.	1.50	2.00	2.00
41. Concrete posts	299 ea.	4.25	4.50	4.50
42. Concrete anchors	52 ea.	10.00	12.00	10.50
43. Plate guard rail	4,368 l. f.	.55	.56	.56
44. Bridge end anchors, type 1	12 ea.	35.00	40.00	37.00
45. Bridge end anchors, type 2	12 ea.	35.00	40.00	37.00
46. Slope paving	440 s. y.	1.75	2.00	2.20
47. Right-of-way markers	184 ea.	2.20	2.50	3.00
48. Sprigging	390,000 s. y.	.02	.02	.02
49. Ditch checks	14,800 s. y.	.35	.33	.35
50. Solid sodding	15,000 s. y.	.20	.20	.32
51. Project marker	1 ea.	15.00	10.00	10.00
52. Project marker, arrow	1 ea.	5.00	5.00	10.00
53. Salvage treated timber	6 Mbm.	25.00	50.00	70.00

* Corrugated metal pipe side drain.

Bridges

LIST OF BIDDERS:

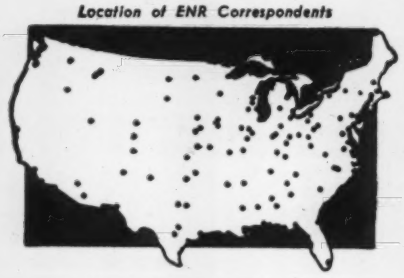
1. C. C. Moore, Panama City, Fla. (contract) $36,775
2. Goodwyn & Murphee, Troy, Ala. 37,023
3. Noonan Constr. Co., Pensacola, Fla. 38,088
4. W. L. Cobb, Tuscaloosa, Ala. 38,180
5. Coggin & Deermont, Chipley, Fla. 38,720

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Remove bridge structures at Sta. 890, 1083, 1275 and 1282	L.S.	$1,250.00	$1,300.00	$1,060.00
2. Treated timber	1.2 Mbm.	150.00	200.00	150.00
3. Treated timber piles	560 l. f.	1.25	1.50	1.00
4. Temp. bridges and detours	L.S.	800.00	800.00	1,250.00
5. Bridge concrete, Cl. A—new	418.3 c. y.	24.00	24.00	25.00
6. Steel test piles	5 ea.	150.00	175.00	150.00
7. Steel pile splices	29 ea.	4.00	3.00	6.00
8. Steel piling	6,330 l. f.	1.55	1.55	1.60
9. Steel pile build-ups	114 ea.	6.00	8.00	10.00
10. Reinforcing steel	77,220 lb.	.045	.045	.039
11. Structural steel	163,080 lb.	.055	.053	.0575

CONSTRUCTION REPORTS

Compiled by Business News Department—Engineering News-Record, 330 W. 42nd St., New York
ELSIE EAVES, Manager *SCOTT McLEOD, Statistician*
(Daily service also available—Write for details)

Location of ENR Correspondents



Symbols and Abbreviations Include:

† Federal Government
★ Project of $500,000 or over
ENR Engineering News-Record
CD Engineering News-Record Construction Daily

Projects—By Size

Construction projects here reported cover the United States and Canada, are of these minimum sizes or larger; water supply, earthwork, waterworks, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

Classes of Construction

(Named in order of Listing)

Water Supply
Sewers, Waste Disposal
Bridges, Grade Cross'gs
Streets & Roads
Earthwork, Waterways
Unclassified
Latin America
Public Buildings
Commercial Buildings
Industrial Buildings

Stages Reported

PROPOSED: (except Streets & Roads):

BIDS ASKED (new announcements only. For full calendar, see also preceding issues of ENR);

LOW BIDDERS: All low bidder news will be the final reports published on the projects involved except where award is not made to the low bidder. In this case, a supplementary contract award report will be published.

CONTRACTS AWARDED: Except awards to low bidders previously reported in low bidder stage.

Dates shown are of issue in which last previous report was published.

WATER SUPPLY

PROPOSED WORK

Calif., Alhambra—Alhambra Valley Water Dist., WW sys. O. K. Smith, Martinez, engr.

Calif., Martinez — Pleasant Hill County Water Dist., c/o County Clerk, $125,000 bond election Nov. 22 for two 10,000 gal. and one 40,000 gal. tanks, extend laterals.

★**Fla., Tampa**—Dpt. Water, exten. mains, constructing water tank. $1,741,000. A. Long, supt. in charge. Application made for WPA gr.

Ia., Knoxville—F. Crawford, city clk., opened bids Oct. 21, WW imprvs., mains, reservoir meter and meter chamber. Suit started in District Court asking that City Council be enjoined from awarding contract. CD 10/1—ENR 10/3.

Ia., Leon—War Dpt., Wash., D. C., 110 acre lake on Grand River to hold 1,000,000,000 gal. water for water supply at new Iowa army cantonment and construction water supply and distr. sys.

Mich., St. Clair—Water sys. exten., pipes, valves, fittings, $37,000. WPA. Pate & Hirn, 532 Michigan Bldg., Detroit, engrs.

Mo., Blue Springs—Jackson Co. Pub. Water Dist. 8, E. Luttrell, Blue Springs, chn., water supply lines for 20 sq. mi. dist. near here. $91,000. Court entered decree for incorporation. Election set for Nov. 19 to vote on incorporation and construction. Henrici-Lowry Co., 114 W. 10 St., Kansas City, Mo., engrs. CD 8/6—ENR 8/8.

Mo., Carrollton—Filtration plant and water distr. sys. Over $100,000. Burns & McDonnell, 107 W. Linwood Blvd., Kansas City, Mo., engrs. CD 10/4/38—ENR 6/2/38.

Mo., Fayette—G. Todd, mayor, bids early in November, purification plant. J. W. Shikles, New York Life Bldg., Kansas City, engrs. CD 10/22—ENR 10/24.

†**N. J., Fort Dix**—Con. Q.M., Governors Island, N. Y., 5,500 ft. c.i. watermains, connections to various other mains. $32,100. WPA. W. D. Cougle, 1102 S. Broad St., Trenton, WPA and owner's engr.

N. Y., Sidney—Bd. Trustees, extending, replacing and laying new watermains. $20,000. Will vote on project Nov. 19.

★**N. C., Wilmington**—J. E. L. Wade, comr. P. Wks., surveys WW supply. $900,000. W. C. Olsen, 5 Exchange Pl., Raleigh, engr. CD 10/31—ENR 11/7.

O., Canton—Stark Co., exten. 1 mi. water lines from Massillon city limits to Genoa. Over $15,000. E. P. Alford, Canton, co. engr.

★**Tenn., Nashville**—Bd. P. Wks., Nashville, 3 m.g. concrete reservoir and laying 16 in. watermain from city main to reservoir. $2,000,000. F. Beaseley, City Hall, engr.

Tex., Beaumont — Completed preliminary estimate and report rehabilitation WW sys. A. C. Moore & Co., 2404 Smith-Young Tower, San Antonio, consult. engrs. R. Edmonds, city mgr.

Wis., Madison—WW plant. $63,000.

BIDS ASKED

Bids Asked November 22

Wis., Fox Point (P. O. Milwaukee)—H. D. Ivins, village clk., furnishing, laying watermains, hydrants, valves, c.i. pipe. C. S. Whitney, 2710 E. Belleview Pl., Milwaukee, engr.

Bids Asked about November 25

O., Ashland — Water softener sys., new pumps, new building, relocation mains leading to structure. $50,000. CD 3/7—ENR 3/14.

†**Wash., Covington**—Bonneville Project, P. O. Box 3537, Portland, Ore., drilling water well for substation, Inv. 1528.

Bids Asked November 26

Calif., Pomona—1 m.g.c. steel reservoir, concrete fdn. $15,000. F. Froehde, City Hall, engr.

Tex., Highland Park—Mayor and Town Council, elevated water storage tank, E. E. Crowell, town secy.

Bids Asked November 27

Tex., Anson—J. M. Arnett, mayor, 7½ mi. water supply mains, c.i. pipe and alternate on 11 in. concrete, and appurtenant imprv. $50,000. Freese & Nichols, Capps Bldg., Fort Worth, engrs.

Que., Senneville—V. H. Graham, town clk., watermains. $25,000. W. S. Lea, 1226 University St., Montreal, engr.

LOW BIDDERS

O., Chillicothe—WW imprv., Contr. B, water conditioning plant and pumping station, from J. W. Harper, 1139 Woodlawn Ave., Napoleon. $138,000. Bids 10/22. CD 10/14—ENR 10/17.

†**Utah, Salt Lake City**—Con. Q.M., Hill Field, Oct. 31, 1,200,000 gal. elevated steel water tank at Salt Lake Municipal Airport, from Pittsburgh-Des Moines Steel Co., 1015 Tuttle St., Des Moines, Ia. $21,943. CD 10/24.

†**Va., Cape Henry**—Con. Q.M., Fort Monroe, Oct. 28, filtration plant addn., from F. J. Westcott Co, North Attleboro, Mass., $38,890. CD 10/1—ENR 10/3.

CONTRACTS AWARDED

Fla., New Smyrna Beach—Wells, pump. sta., etc., to Layne-Atlantic Co., Cromwell Rd. and Flanders Ave. $63,000. Bids 10/28. CD 10/16.

Ind., Connersville—Bd. P. Wks., WW imprv., diesel engine and generator, heat exchanger, auxiliary equip., piping, electric work, to Cooper-Bessemer Co., Mt. Vernon, O. $40,000. Bids 9/16, awarded 10/29. CD 8/23—ENR 8/29.

†**Mich., Battle Creek**—Con. Q.M., Fort Custer, water distribution sys., to Christopher Constr. Co., Cleveland, O. $48,466.

Minn., White Bear Lake (br. St. Paul)—Watermains, WPA. $41,417.

N. J., Bridgeton—Laying new watermains and resurfacing over same, WPA. $35,391. CD 8/28—ENR 9/5.

†**N. J., Fort Hancock**—Con. Q.M., 90 Church St., New York, N. Y., exten. existing water and sewerage sys. addn., to Spinello Constr. Co., 437 Riverside Ave., Newark, $67,407. Bids 10/31. CD 10/23.

N. Y., Colonie (br. Albany)—Latham Water Dist., Town Hall, Colonie, water supply addn., to B. Trimpoli, 251 Altamont Ave., Schenectady. Est. $20,000. Bids 10/28. CD 10/16—ENR 10/24.

N. Y., Highland—Reservoir with concrete corewall, earth dam, valve chamber, pump house, aerator, exten. WW sys., WPA. Over $50,000. C. L. Post, Old P. O. Bldg. Albany, ch. engr. WPA projects.

N. C., Bailey—C. H. Eatmon, mayor, installing water and sewer facilities. WPA. $71,800.

N. D., Bismarck—H. M. Atkinson, city aud., filtration plant and water softening equip., to Meinecke & Johnson Co., Fargo. $53,958. Bids 10/28. CD 10/24.

O., Newark—Exten. water distr. lines to Fulton School and vicinity. WPA. $46,000. C. H. Wells, city engr.

Pa., York—Schmidt & Ault Paper Co., Penn St. and Kings Mill Rd., steel water tower and water supply sys. for plant, to Dietz & Smith, York. Est. $15,000.

Tex, Frankston—R. Berry, mayor, WW sys. imprvs., c.i. pipe, fire hydrants, new turbine well pump. Owner builds. $20,000. CD 9/1—ENR 9/7.

Tex., Grand Prairie—North American Aviation, Inc., Commerce St., Dallas and Grand Prairie, drilling, casing, developing 2 deep water wells, to Layne Texas Co., 6931 Hsbg. St., Houston, about $68,000. Allen & Kelley, Indianapolis, Ind., engrs.

Tex., Grand Prairie—G. H. Turner, mayor, WW sys. expansion, laying water distr. lines, fire hydrants, own forces. $25,000. CD 7/15—ENR 7/18.

Tex., Odem—H. H. Montgomery, mayor, imprv. existing WW sys., c.i. mains, deep water well, cased and complete development, concrete reservoir, aeration and treating plant. WPA. $55,000. M. C. St. John, 4101 Polk St., Houston, engr.

Wis., Marshall—C. Cole, town clk., municipal water sys. WPA. $42,716. General Eng. Co., Portage, engr.

Wis., Weyauwega—P. M. Baxter, city clk., exten. water distr. sys. WPA. $43,140.

Man., Tuxedo—J. D. Whiting, municipality clk., 702 Trust Bldg., Winnipeg, watermain exten., to J. L. Toby, 143 Gomez St., Winnipeg. Est. $15,000. CD 10/23—ENR 11/7.

N. S., Sydney—Dpt. National Defense, Ottawa, Ont., outside fire protection and watermains and alterations to warehouse at H.M.C. Dockyard, to Hall Constr. Co. Ltd., 8 Norwood Ave., Halifax. $66,694.

N. S., Sydney—Dominion Govt., Ottawa, Ont., watermain at H.M.C. Dockyard, etc., to Hall Constr. Co. Ltd, 8 Norwood St., Halifax. Est. $15,000. Bids 9/27. CD 9/25.

SEWERS, WASTE DISPOSAL

PROPOSED WORK

★**Calif., Long Beach**—Constructing Northwest storm drain. $900,000. G. E. Baker, engr., City Hall, authorized to prepare plans.

Calif., Menlo Park—Menlo Park Sanitary Dist., 2,380 lin. ft. 10 to 14 in. vitr. clay and c.i. sewers for Ringwood Park Area.

Mich., Ironwood—Sewage treatment plant. $40,000. A. G. Wood, city mgr. Suhr, Berryman, Peterson & Suhr, 130 N. Wells St., Chicago, Ill., engrs.

Minn., Detroit Lakes—E. J. Bestick, city clk., sewage disposal plant addn., $50,000-$60,000. May hold bond election for same.

Minn., Kasson—N. H. Hempsted, village clk., sewerage disposal plant, sewer and watermain exten. Over $50,000. WPA. Druar & Milinowski, 1411 Pioneer Bldg., St. Paul, engrs.

Minn., North Mankato (P. O. Mankato)—Defeated $52,300 bonds, sewage disposal plant. M. R. Wigley, city clk. G. M. Orr & Co., 342 Baker Arcade Bldg., Minneapolis, engrs. CD 1022—ENR 10/24.

Neb., Kearney—H. J. Nelson, city clk., sewage disposal plant. $200,000.

†**N. J., Fort Dix**—Con. Q. M., Governors Island, N. Y., imprv. sewerage sys. and 2 mi. narrow gage railroad to carry supplies to various ranges. $63,868. WPA. W. D. Cougle, 1102 S. Broad St., Trenton, WPA & owner's engr.

N. Y., Stillwater—Sewer Dist., sewers, disposal plant. $200,000. Whitman, Requardt & Smith, 11 N. Pearl St., Albany, engrs. Probably WPA.

★**Pa., Phila.**—City Council, City Hall, sewers in new residential districts. $1,000,000 appropriated.

S. C., Rock Hill—J. J. Rauch, city mgr., incinerator, water and sewer exten. abattoir, election soon $100,000 bonds.

Wis., Hudson—W. R. Foss, city clk., garbage incinerator plant. Consoer, Townsend & Quinlan, 211 W. Wacker Dr., Chicago, Ill., engrs.